

CLAIMS:

1. A method for treating industrial wastewater, comprising:
 - (a) introducing powder of a ferromagnetic particulate material into the wastewater in an amount effective to provide magnetic susceptibility to sludge;
 - 5 (b) adjusting a value of a pH of the wastewater, to form a liquid effluent of the wastewater having a predetermined value of the pH;
 - (c) oxidizing the wastewater having an adjusted value of the pH;
 - (d) flocculating the wastewater, to form flakes of the magnetic sludge in water; and
 - 10 (e) separating the magnetic sludge from the water.
2. The method of claim 1 wherein the wastewater includes at least one component selected from heavy metals, oil products, detergents, phenols, dyes, complexions, and complexionates.
3. The method of claim 1 wherein particle size of said ferromagnetic particulate material is in the range of about 1 to 100 microns.
- 15 4. The method of claim 1 wherein of said ferromagnetic particulate material is made of ferrites of heavy metals.
5. The method of claim 4 wherein the ferrites include at least one element selected from zinc ferrite, magnetite (Fe_3O_4), gamma-hematite (gamma- Fe_2O_3), Barium ferrite ($BaFe_2O_4$).
- 20 6. The method of claim 1 wherein the amount of said ferromagnetic particulate material introduced into the wastewater is in the range of about 5 to 30 mass % of the entire amount of inorganic coagulants introduced into the wastewater.
7. The method of claim 1 wherein the adjusting of the value of the pH of the wastewater is carried out by introducing into the wastewater a coagulation agent.
- 25 8. The method of claim 7 wherein said coagulation agent is a basic coagulant elevating the value of the pH of the wastewater.
9. The method of claim 8 wherein the pH of the wastewater is in the range of about 9 to 14.

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10. The method of claim 8 wherein the powder of ferromagnetic particulate material is introduced before the basic coagulant.
11. The method of claim 8 wherein the powder of ferromagnetic particulate material is introduced after the basic coagulant.
- 5 12. The method of claim 8 wherein the powder of ferromagnetic particulate material is introduced simultaneously with the basic coagulant.
13. The method of claim 9 wherein the oxidizing of the wastewater is carried out by adding a first oxidizer being efficient at high pH.
14. The method of claim 13 wherein the first oxidizer is sodium hypo chlorite.
- 10 15. The method of claim 7 wherein said coagulation agent is an acidic coagulant decreasing the value of the pH of the wastewater.
16. The method of claim 15 wherein the pH of the wastewater is in the range of about 6 to 9.
- 15 17. The method of claim 15 wherein the acidic coagulant is introduced after the basic coagulant.
18. The method of claim 15 wherein the acidic coagulant is a salt of iron or aluminum.
19. The method of claim 15 wherein the oxidizing of the wastewater is carried out by adding a second oxidizer being efficient at low pH.
- 20 20. The method of claim 19 wherein the second oxidizer is selected from hydrogen peroxide and ozone.
21. The method of claim 1 wherein the flocculating of the wastewater includes introducing a cationic flocculant into the wastewater, thereby forming a layer of cationic flocculant on the surface of the coagulated particles.
- 25 22. The method of claim 21 wherein the flocculating of the wastewater further includes introducing a cationic flocculant into the wastewater, thereby forming a layer of the anionic flocculant on a top the cationic flocculant layer.
23. The method of claim 19 wherein the oxidizing of the wastewater with the second oxidizer is carried out after the flocculating of the wastewater.

24. The method of claim 19 wherein the oxidizing of the wastewater with the second oxidizer is carried out before the flocculating of the wastewater.
25. The method of claim 19 wherein the oxidizing of the wastewater with the second oxidizer is carried out before and after the flocculating of the wastewater.
- 5 26. The method of claim 1 wherein the separating of the magnetic sludge from the water is carried out by applying a magnetic field across an effluent of the wastewater after the flocculating.
- 10 27. The method of claim 26 wherein a linear velocity of an effluent flow is greater than 100 m/hour, the sludge has the floccules lesser than 10 mm in size, and a strength of the magnetic field is greater than 0.1 Tesla.
28. The method of claim 1 further comprising the step of dewatering the sludge.
29. The method of claim 1 further comprising the step of packaging and storing the sludge.
- 15 30. The method of claim 1 further comprising the step of recycling a portion of the magnetic sludge, to use the sludge as magnetic reagent.
31. The method of claim 30 wherein the fraction of the recycled sludge is in the range of about 10 mass % to 50 mass % of a total sludge mass.
32. The method of claim 1 further comprising the step of discharging the water separated from the sludge into a sewage network.
- 20 33. The method of claim 1 further comprising the step of returning the water separated from the sludge to a technological process.
34. The method of claim 1 further comprising the step of passing the water separating from the sludge through a layer of catalyst in the form of an ion-exchange fiber material.
- 25 35. The method of claim 34 wherein the water separated from the sludge is first passed through an ion-exchange catalyst, being in its neutral form, and thereafter is passed through the ion-exchange catalyst, being in its basic form, thereby to provide more complete removal of the intermediate products of the organic substance oxidation destruction.
- 30 36. A system for treating industrial wastewater, comprising:

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a static mixer configured for continuous mixing the wastewater supplied thereto with desired reagents;

5 a feeder of a magnetic powder configured for providing a ferromagnetic particulate material to said static mixer;

at least one coagulator apparatus coupled to said static mixer, and configured for preparation of a coagulation agent and supplying thereof to said static mixer;

10 at least one oxidizer apparatus coupled to said static mixer and configured for supplying an oxidizer thereto;

at least one flocculant apparatus coupled to said static mixer and configured for supplying a flocculant agent thereto to form flakes of the magnetic sludge in water; and

15 a magnetic separator configured for receiving the wastewater flowing downwardly from said static mixer and configured for applying a magnetic field across an effluent of the wastewater, thereby to separate the magnetic sludge from the water.

37. The system of claim 36 comprising a sludge suspension container downstream of said magnetic separator.

38. The system of claim 37 comprising a dryer downstream of said sludge suspension container and communicating with the static mixer for partial returning the magnetic sludge thereto.

39. The system of claim 36 comprising a first circulation pump for supplying the wastewater to said static mixer.

40. The system of claim 38 comprising a second circulation pump for supplying the magnetic sludge to said static mixer.

41. The system of claim 36 comprising a control unit configured for providing a control of the system.

42. The system of claim 36 comprising at least one sensor configured for generation a signal indicating at least a pressure or flow level.

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43. The system of claim 36 comprising at least one water quality sensor adapted to indicate a water quality.
44. The system of claim 36 comprising at least one control valve adapted for regulating a wastewater flow.
- 5 45. The system of claim 36 comprising at least one reagent supply valve.

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